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VERIFICATION OF TRANSLATION

U.S. Patent Application No.: 10/550,865

Title of the Invention: REINFORCING CORD FOR RUBBER
REINFORCEMENT AND RUBBER PRODUCT INCLUDING THE SAME

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am the translator of the document attached and I state that the following
is a true translation to the best of my knowledge and belief of Japanese
Patent Application No. 2003-105709 (filing date: April 9, 2003).

At Osaka, Japan

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Signature of translator:



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Applicant(s): NIPPON SHEET GLASS COMPANY, LIMITED

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[DOCUMENT NAME] SPECIFICATION

[TITLE OF THE INVENTION] RUBBER-REINFORCING CORD AND
RUBBER PRODUCT INCLUDING THE SAME

[CLAIMS]

- 5 [Claim 1] A rubber-reinforcing cord with a carbon fiber strand arranged at the center and a plurality of glass fiber strands arranged therearound.
- [Claim 2] The rubber-reinforcing cord according to claim 1, wherein the carbon fiber strand accounts for 20 to 80 vol% of the total volume of the carbon fiber strand and the glass fiber strands.
- 10 [Claim 3] The rubber-reinforcing cord according to claim 1 or 2, wherein the carbon fiber strand has a twist number of 0 to 5.0 times/25 mm.
- [Claim 4] The rubber-reinforcing cord according to any one of claims 1 to 3, wherein the glass fiber strands have a twist number of 0.25 to 5.0 times/25 mm.
- 15 [Claim 5] The rubber-reinforcing cord according to any one of claims 1 to 4, wherein the glass fiber strands have been treated with a treatment solution containing, as its main component, a mixture of a rubber latex and an initial condensate of resorcinol and formalin.
- [Claim 6] The rubber-reinforcing cord according to any one of claims 1 to 20 5, wherein the cord has a final twist number of 0.5 to 10 times/25 mm.
- [Claim 7] The rubber-reinforcing cord according to any one of claims 3 to 6, wherein the cord has been finally twisted in an opposite direction to a direction in which the glass fiber strands have been primarily twisted.
- [Claim 8] The rubber-reinforcing cord according to claim 7, wherein the 25 glass fiber strands have been twisted in the same direction as a direction in which the carbon fiber strand has been twisted if it has been primarily twisted.
- [Claim 9] The rubber-reinforcing cord according to any one of claims 1 to 8, wherein a surface thereof is overcoated with rubber.
- 30 [Claim 10] A rubber product comprising a rubber-reinforcing cord according to any one of claims 1 to 9.
- [Claim 11] The rubber product according to claim 10, wherein the content of the rubber-reinforcing cord is 10 wt.% to 70 wt.%.
- [Claim 12] The rubber product according to claim 10 or 11, being a 35 rubber belt or a rubber crawler.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

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[Technical field to which the invention pertains]

The present invention relates to a rubber-reinforcing fiber cord that is used for reinforcing rubber products such as rubber belts and tires and that is excellent in bending fatigue resistance and dimensional stability, and
5 a rubber product reinforced with the rubber-reinforcing cord.

[0002]

[Prior Art]

Reinforcing fibers such as glass fibers and aramid fibers are used widely as reinforcing materials for rubber products such as rubber belts and
10 tires.

[0003]

These rubber products are subjected to bending stress repeatedly and thereby the performance thereof tends to deteriorate due to bending fatigue. Accordingly, exfoliation tends to occur between reinforcing fibers and a rubber matrix, or deterioration in strength tends to occur due to
15 fraying of the reinforcing fibers. Moreover, a toothed belt that is used for driving a camshaft of an internal combustion engine of an automobile is required to have high dimensional stability to keep suitable timing. Furthermore, recently, it is required to have high elasticity and high
20 strength that allows it to withstand high loads, in applications not only for driving a camshaft but also for auxiliary drive of, for example, an injection pump or for power transmission in industrial machines.

[0004]

Under such circumstances, high-strength glass fibers and
25 polyparaphenylene terephthalamide fibers (hereinafter, aramid fibers) have been mainly used as the fibers employed for reinforcing belts, but recently, carbon fibers and polyparaphenylene benzobisoxazole (hereinafter, abbreviated as "PBO") fibers also are proposed as new materials. For example, Patent Document 1 proposes carbon fibers to be used as a tension
30 member of a toothed belt.

[0005]

[Patent Document 1]

JP8(1996)-174708 A

[0006]

35 [Problems to be solved by the invention]

As described above, rubber-reinforcing fiber cords are required to have, for example, high strength, high elasticity, as well as bending

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flexibility and fraying resistance. However, when one type of fibers are used as in the conventional case, it is difficult to achieve a balance between strength and flexibility. For instance, when carbon fibers are used for a belt-reinforcing cord, the cord has high strength and high elasticity but poor fraying-fatigue resistance and therefore has a problem in that its strength tends to deteriorate.

[0007]

The present invention proposes a rubber-reinforcing fiber cord that has high strength, high elasticity, and excellent bending fatigue resistance while compensating for a disadvantage in poor fraying resistance of carbon fibers.

[0008]

[Means for solving problems]

The present invention provides a rubber-reinforcing cord with a carbon fiber strand arranged in the center and a plurality of glass fiber strands arranged therearound.

[0009]

The carbon fiber strand arranged in the centre of the cord provides the cord with high tensile strength and excellent dimensional stability according to its properties. On the other hand, the glass fiber strands arranged around the carbon fiber strand of the cord serve to relax tensile and compressive stresses when the cord and matrix rubber reinforced with the cord are bent. A combination of a carbon fiber strand and glass fiber strands makes it possible to obtain a hybrid cord that is excellent in strength, dimensional stability, bending fatigue resistance, and adhesiveness to rubber.

[0010]

A carbon fiber strand whose modulus of elongation is 155 to 650 GPa (with a density of 1.74 to 1.97 g/cm³) can be used as the carbon fiber strand to be arranged in the center of the cord. A strand formed of a bundle of 500 to 25000 carbon filaments with diameters of 4 μm to 8 μm to have 30 to 2000 tex is used suitably.

[0011]

The carbon fiber strand arranged in the center of the cord provides the cord with high tensile strength and excellent dimensional stability according to its properties. However, if the ratio of the carbon fiber strand in the cord increases, the static strength increases but the flexibility

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deteriorates. Accordingly, with respect to the ratio of the carbon fiber strand to be used, the total cross section of the carbon fiber strand is preferably 80% or less and more preferably 70% or less of the gross cross section of the cord (that has not been overcoated; the same applies below).

- 5 If the ratio of the carbon fiber strand to be used is too low, the effects for improving the tensile strength and dimensional stability that are provided by the use of the carbon fiber strand cannot be obtained sufficiently. Accordingly, with respect to the ratio of the carbon fiber strand to be used, the total cross section of the carbon fiber strand is preferably at least 20% ,
10 and more preferably at least 40% of the gross cross section of the cord. In the description below, the percentage ratio of the total cross section of the carbon fiber strand to the gross cross section of the hybrid cord (i.e. the total cross section of the fiber strands) is referred to as a "cross-sectional percentage ratio".

15 [0012]

- The carbon fiber strand to be arranged in the center may be untreated one with no twist but may be twisted and coated with an adhesive for improving adhesiveness and fraying resistance. The adhesive is not particularly limited. An adhesion treatment can be carried out using, for
20 example, a treatment solution (hereinafter also referred to as a "RFL") containing, as its main component, a mixture of a rubber latex and an initial condensate of resorcinol and formalin, and an epoxy compound, or an isocyanate compound, for example. A suitable twist (primary twist) number of the carbon fiber strand is 0 to 5.0 times/25 mm.

25 [0013]

- The glass fiber strands to be arranged around the carbon fiber strand of the cord have a lower elastic modulus and high fraying resistance as compared to the carbon fiber strand to be arranged in the center. That is, the peripheral side in the cord is required to have a structure that
30 relaxes tensile and compressive stresses when the cord and matrix rubber reinforced with the cord are bent. According to the present invention, such a function can be obtained by arranging the glass fiber strands on the peripheral side in the cord. Examples of the glass fiber strands include those with an elastic modulus of 60 to 80 GPa (with a density of 2.5 g/cm³,
35 280 to 350 g/d).

[0014]

Adhesiveness to matrix rubber also is important for the glass fiber

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strands arranged on the peripheral side in the cord. Accordingly, the glass fiber strands generally are subjected to an adhesion treatment with, for example, RFL as well as twists. A suitable twist number of the glass fiber strands is 0.25 to 5.0 times/25 mm. Preferably, the glass fiber strands are
5 twisted in the same direction as that in which the carbon fiber strand to be arranged in the center of the cord is twisted (if it is twisted).

[0015]

The RFL treatment is a treatment in which filaments are immersed in the aforementioned RFL and are then subjected to a heat treatment
10 (heating treatment). Examples of the rubber latex that can be used in the RFL treatment include an acrylic rubber latex, an urethane latex, a styrene-butadiene rubber latex, a nitrile rubber latex, a chlorosulfonated polyethylene latex, modified latices thereof, and mixtures thereof, but it is not particularly limited. A common adhesive such as, for instance, epoxy or
15 isocyanate may be used.

[0016]

A fiber strand is obtained by forming a strand through bundling of fiber filaments that have been subjected to a treatment such as the RFL treatment as required, and primarily twisting a predetermined number of
20 strands as required.

[0017]

In the present invention, a preferable embodiment is a rubber-reinforcing hybrid cord 1 in which as shown in FIG. 1, one or a plurality of carbon fiber strands 3 are arranged in the center and a plurality
25 of glass fiber strands 2 are arranged therearound.

[0018]

Examples of the glass fibers to be used for the glass fiber strands 2 include E-glass fiber filaments and high strength glass fiber filaments. A glass fiber strand to be used preferably for the glass fiber strands is a strand
30 with a size of 20 to 480 tex that is obtained by bundling 200 to 2400 glass filaments with diameters of 7 μ m to 9 μ m and then primarily twisting them.

[0019]

In order to manufacture such a hybrid cord, a guide is used that has a center guide hole and a plurality of peripheral guide holes arranged at
35 positions located on substantially equal radius from the center of the center guide hole. One carbon fiber strand or a plurality of carbon fiber strands that have no twist or that have been primarily twisted are put into the

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center guide hole. The glass fiber strands that have been primarily twisted are put into the plurality of peripheral guide holes. These strands are finally twisted to be formed into a hybrid cord. The twist number employed in the final twist is preferably about 0.5 to 10 times/25 mm. The direction
5 of the final twist may be the same as or opposite to that of the primary twist of the glass fiber strands. For instance, when higher bending fatigue resistance is required, the final twist and the primary twist may be carried out in the same direction (to result in a so-called Lang lay). When expressed in terms of [the number of carbon fiber strands] : [the number of
10 glass fiber strands], examples of the structure of a hybrid cord formed of carbon fiber strands and glass fiber strands include 1 : 3 to 30, 2 : 6 to 30, and 3 : 10 to 40. The carbon fiber strands often have relatively lower adhesiveness to a rubber matrix as compared to the glass fiber strands. Accordingly, it is preferable that a cord be configured in such a manner that
15 the carbon fiber strands are surrounded by the glass fiber strands so as to be prevented from coming into direct contact with the rubber matrix.

[0020]

The apparatuses for doubling and twisting fiber strands that are used for manufacturing the hybrid cord of the present invention are not
20 specified. Various apparatuses can be used including a ring twister, a flyer twisting frame, a strander, etc.

[0021]

The rubber-reinforcing hybrid cord of the present invention may have a structure of one rope or may have a structure of a bamboo-blind cord
25 formed of a plurality of cords that are arranged in parallel in the form of a sheet and that are bonded loosely.

[0022]

When the above-mentioned treatment agent does not allow sufficiently high adhesiveness to the matrix rubber to be obtained, another
30 adhesive further may be applied to the surface of the hybrid cord or the hybrid cord may be overcoated for improving the affinity with rubber through formation of a rubber coating layer, if necessary. For the rubber to be used for overcoating, hydrogenated nitrile rubber, chlorosulfonated polyethylene (CSM) rubber, chloroprene rubber, natural rubber, urethane
35 rubber, etc. can be used together with a crosslinking agent. In many cases, the rubber to be used for overcoating is selected from well-known various rubbers according to the type of the matrix rubber. The amount of solid

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content of the overcoat that has adhered is not particularly limited but is preferably 2.0 wt.% to 10.0 wt.% with respect to the weight of the hybrid cord obtained before being overcoated.

[0023]

- 5 The rubber-reinforcing hybrid cord of the present invention is suitable to be used for reinforcing, for example, rubber belts such as toothed belts and moving belts, rubber crawlers, etc., as a rubber-reinforcing cord. It also can be used for reinforcing other rubber members.

[0024]

- 10 In the rubber product of the present invention, it is preferable that the content of the rubber-reinforcing hybrid cord of the present invention be approximately 10 wt.% to 70 wt.% of the weight of the rubber product.

[0025]

[Mode for carrying out the invention]

- 15 [Example 1]

- A 400-tex carbon fiber strand (the outer diameter: about 0.76 mm, the filament diameter: 7.0 μ m, the number of filaments: 6000, the elastic modulus: 235 GPa, and the density: about 1.76 g/cm³; a product with no twist, manufactured by Toho Tenax Co., Ltd.) was prepared. Furthermore,
20 a RFL treatment solution (a resorcinol-formalin condensate (with a solid content of 8 wt.%) : a vinylpyridine-styrene-butadiene latex (with a solid content of 40 wt.%) : CSM (with a solid content of 40 wt.%) = 2 : 13 : 6 (solid-content weight ratio)) was prepared. The aforementioned carbon fiber strand was impregnated with the aforementioned RFL treatment
25 solution and was then heat-treated (dried at 180°C for 120 seconds). Thus a RFL-treated carbon fiber strand (the amount of RFL that adhered thereto: 20 wt.%) was obtained. In the same manner, a glass fiber strand was impregnated with the above-mentioned RFL treatment solution, was heat-treated (dried at 180°C for 120 seconds), and was then primarily
30 twisted at 2.0 times/25 mm in the *S* direction. Thus an about 100-tex glass fiber strand with an E-glass composition (the outer diameter: about 0.35 mm, the filament diameter: 9 μ m, the number of filaments: 600, the elastic modulus: 70 GPa, the density: about 2.5 g/cm³, and the amount of RFL that adhered thereto: 20 wt.%; manufactured by Nippon Sheet Glass Co., Ltd.)
35 was prepared. Thereafter, one RFL-treated carbon fiber strand was arranged in the center of a cord and nine glass fiber strands were arranged around the carbon fiber strand of the cord, which was then finally twisted at

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2.0 times/25 mm in the Z direction so as to be arranged as shown in FIG. 1. Thus, a rubber-reinforcing hybrid cord with a cross-sectional diameter of about 1.15 mm was produced. The cross-sectional percentage ratio of the cord and the linear density (the weight g per length of 1000 m) of the cord were 34% and 1650 tex (g/1000 m), respectively.

[0026]

A second treatment agent for overcoating with the composition indicated in Table 1 was applied to the cord and then was dried. As a result, a cord treated with the second treatment agent was obtained. The solid content ratio of the second treatment agent that had adhered to the cord was 5 wt.% of the cord. The cord treated with the second treatment agent was subjected to measurements of tensile strength, elongation (%) at break, and tensile load (N/cord) applied per cord when the elongation in length of the cord reached 0.4% through application of a tensile load to the cord. A greater tensile load per cord applied at the time of the elongation of 0.4% indicates better dimensional stability. The tensile strength (initial) per cord was 710 N/cord, the elongation at break was 2.7%, and the tensile load per cord applied at the time of the elongation of 0.4% was 110 N/cord.

[0027]

20 [Table 1]

CSM (manufactured by Toso Co., Ltd.,		
Product Name TS-340; <u>a chlorine content</u>		
25	<u>is 43 wt.%, and a sulfur content is 1.1 wt.%)</u>	<u>5.25 parts by weight</u>
	<u>P-dinitrosobenzene</u>	<u>2.25 parts by weight</u>
	<u>Carbon Black</u>	<u>3.0 parts by weight</u>
Mixed Solvent of Xylene and Trichloroethylene		
(the mixing ratio (weight ratio) between xylene		
30	and trichloroethylene = 1.5 : 1.0)	85.0 parts by weight

[0028]

In addition, one 300-mm long cord treated with the second treatment agent was arranged on a matrix rubber sheet having the composition indicated in Table 2, a width of 10 mm, a length of 300 mm, and a thickness of 1 mm. Subsequently, a matrix rubber sheet with the same

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size was superimposed thereon, which was then subjected to press vulcanization from its both sides at 150°C for 20 minutes. Thus, a planar belt-like specimen was produced.

[0029]

5 【Table 2】

	Hydrogenated Acrylonitrile-Butadiene Rubber	
	(Zetpol 2020, manufactured by JAPAN ZEON Corporation)	100 parts by weight
	Zinc Oxide, Grade 1	5 parts by weight
10	Stearic Acid	1.0 part by weight
	HAF Carbon	60 parts by weight
	Trioctyl Trimellitate	10 parts by weight
	4,4-(α,α -Dimethylbenzyl)Diphenylamine	1.5 parts by weight
	2-Mercaptobenzimidazole Zinc Salt	1.5 parts by weight
15	Sulfur	0.5 parts by weight
	Tetramethylthiuramsulfide	1.5 parts by weight
	Cyclohexyl-Benzothiazylsulfenamide	1.0 part by weight

[0030]

20 As shown in FIG. 2, this specimen 4 was hung on pulleys 5 and 6 of a bending tester that included one flat pulley 5 with a diameter of 25 mm, a motor (not shown), and four guide pulleys 6. A weight was attached to one end 7 of the specimen 4 to apply an initial tensile force of 9.8 N to the specimen 4. The other end 8 of the specimen 4 was made to reciprocate at

25 a moving distance of 10 cm in the directions indicated with the arrow shown in the drawing, and thereby the specimen 4 was bent repeatedly by the part located along the flat pulley 5. It was reciprocated 10000 times at room temperature to be bent, and the tensile strength (per cord) was measured after the bending test in order to evaluate the bending fatigue resistance.

30 The ratio of this strength to the tensile strength (per cord) obtained before the bending test was determined as a tensile strength retention (%). A higher value of the tensile strength retention indicates higher bending fatigue resistance. The tensile strength retention was 83%.

[0031]

35 【Example 2】

A 1770-tex cord with a cross-sectional diameter of 1.18 mm was produced in the same manner as in Example 1 except that an identical

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carbon fiber strand treated with RFL that had been primarily twisted at 2.0 times/25 mm in the *S* direction was used instead of the carbon fiber strand with no twist used above in Example 1. Production of a cord treated with the second treatment agent (the solid content ratio of the second treatment agent that had adhered to the cord: 5 wt.%) as well as production and evaluation of the specimen were carried out in the same manner. The tensile strength (initial) per cord was 1080 N/cord, the elongation at break was 2.1%, the tensile load applied per cord when the elongation was 0.4% was 200 N/cord, and the tensile strength retention was 71%.

10 [0032]

[Comparative Example 1]

Eleven glass fiber strands with the E-glass composition that had been subjected to the RFL treatment and then had been primarily twisted in the *S* direction, which were identical to those used in Example 1, were bundled and then were finally twisted at 2.0 times/25 mm in the *Z* direction in the same manner as in Example 1 using no carbon fiber strand. Thus a rubber-reinforcing cord with a cross-sectional diameter of about 1.13 mm was produced. The cross-sectional percentage ratio of the carbon fiber strand of this cord and the linear density (the weight g per length of 1000 m) of the cord were 0% and 1440 tex, respectively. Production of a cord treated with the second treatment agent (the solid content ratio of the second treatment agent that had adhered to the cord: 5 wt.%) as well as production and evaluation of the specimen were carried out in the same manner as in Example 1. The tensile strength (initial) per cord was 890 N/cord, the elongation at break was 3.4%, the tensile load applied per cord when the elongation was 0.4% was 80 N/cord, and the tensile strength retention was 51%.

20 [0033]

[Comparative Example 2]

A 800-tex carbon fiber strand (the filament diameter: 6.9 μm , the number of filaments: 12000, the elastic modulus: 240 GPa, the density: about 1.80 g/cm³; a product with no twist, manufactured by Toho Tenax Co., Ltd.) was twisted at 2.0 times/25 mm. Thereafter, the second treatment agent was applied thereto so that the amount of the solid content that adhered thereto was 5 wt.% and was then dried. Thus, a 1140-tex cord with a cross-sectional diameter of 1.10 mm was produced. Subsequently, production and evaluation of the specimen were carried out in the same

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manner as in Example 1. The tensile strength (initial) per cord was 1440 N/cord, the elongation at break was 2.1%, the tensile load applied per cord when the elongation was 0.4% was 90 N/cord, and the tensile strength retention was 68%.

5 [0034]

In Table 3, evaluation results are indicated including the type and diameter of the strands, the primary twist, the final twist, the diameter of the cord, the linear density, the tensile load (N/cord) applied when the elongation of the cord was 0.4%, and the tensile strength retention obtained after the bending test with respect to Examples 1 and 2 as well as Comparative Examples 1 and 2.

[0035]

[Table 3]

15	<u>Center</u>		<u>Periphery</u>		Final twist	Cross- sectional diameter	Linear density	Tensile load at the time of 0.4% - elongation	Tensile strength retention
	Type Primary of twist fiber	Type Primary of twist fiber							
20	Size (times/mm)		Number (times/mm)		(times/mm)	(mm)	(g/1000m)	(N/cord)	(%)
	Examples								
	1 Carbon fiber	None	E-glass	S	Z	1.15	1650	110	83
25	400 tex	0	9	2.0	2.0				
	2 Carbon fiber	S	E-glass	S	Z	1.18	1770	200	71
	400 tex	2.0	9	2.0	2.0				
30	Comparative Examples								
	1 E-glass 11	S 2.0	-- --	-- --	Z 2.0	1.13	1440	80	51
	2 Carbon fiber	--	--	--	--	1.10	1140	90	68
35	800 tex	2.0	--	--	--				

[0036]

As is clear from Table 3, in Examples 1 and 2 where hybrid cords were used in which the carbon fiber strand was arranged in the center and the glass fiber strands were arranged on the peripheral side in the cord, the tensile load applied when the elongation was 0.4% was high, specifically 110 N/cord and 200 N/cord, and the tensile strength retention obtained after the bending test also was high, specifically 83% and 71%. Accordingly, it was

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found that they were excellent in dimensional stability and bending fatigue resistance. On the other hand, in Comparative Example 1 in which the glass fiber strands alone were used, the tensile load applied when the elongation was 0.4% was low, specifically 80 N/cord, and the tensile strength retention also was low, specifically 51%. Hence, it was found that it was inferior as compared to Examples 1 and 2 in terms of both the dimensional stability and the bending fatigue resistance. Furthermore, in Comparative Example 2 in which a cord formed of a carbon fiber strand alone was used, the tensile load applied when the elongation was 0.4% was 90 N/cord and the tensile strength retention was 68%. It was found that although both the dimensional stability and the bending fatigue resistance were higher as compared to Comparative Example 1 but were inferior as compared to Examples 1 and 2.

[0037]

When Example 1 and Example 2 are compared to each other, the tensile strength retention obtained after the bending test of Example 1 is higher than that of Example 2, while the tensile load applied when the elongation was 0.4% of Example 2 is higher than that of Example 1. Accordingly, Example 1 has higher bending fatigue resistance while Example 2 has higher dimensional stability. Generally, in the case of a twisted cord, the bending fatigue resistance improves with an increase in twist number while the dimensional stability improves with a decrease in twist number. The cord of the present invention has a two-layer structure formed of a carbon fiber arranged at the center and glass fibers arranged in the outer layer in the cord. Therefore in the case of Examples 1 and 2 where the cord was finally twisted in the opposite direction to that of primary twist, the twist number of the carbon fiber arranged at the center decreases after the final twist is completed. When the final twist is completed, the carbon fiber strand (with no twist) of Example 1 is twisted in the *Z* direction at about 2.0 times/mm, while the carbon fiber strand of Example 2 has a twist number of almost zero in the *S* direction. Conceivably, this causes the difference in performance described above. Accordingly, it is preferable that the carbon fiber strand have no twist or have been twisted at less than 0.5 time/mm when the bending fatigue resistance is considered as important and it have been twisted at 0.5 to 5.0 times/mm when the dimensional stability is considered as important.

[0038]

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[Effects of the invention]

As described above, the present invention provides: a rubber-reinforcing hybrid cord that has a sufficiently high tensile strength suitable for a rubber-reinforcing cord and that has excellent bending fatigue resistance, dimensional stability, and adhesiveness to rubber; and rubber belts such as a toothed belt reinforced with the rubber-reinforcing hybrid cord as well as other rubber products.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[FIG. 1]

FIG. 1 is a schematic cross-sectional view of a rubber-reinforcing hybrid cord according to an embodiment of the present invention.

[FIG. 2]

FIG. 2 is a diagram for explaining the method of testing the bending properties in the examples and comparative examples.

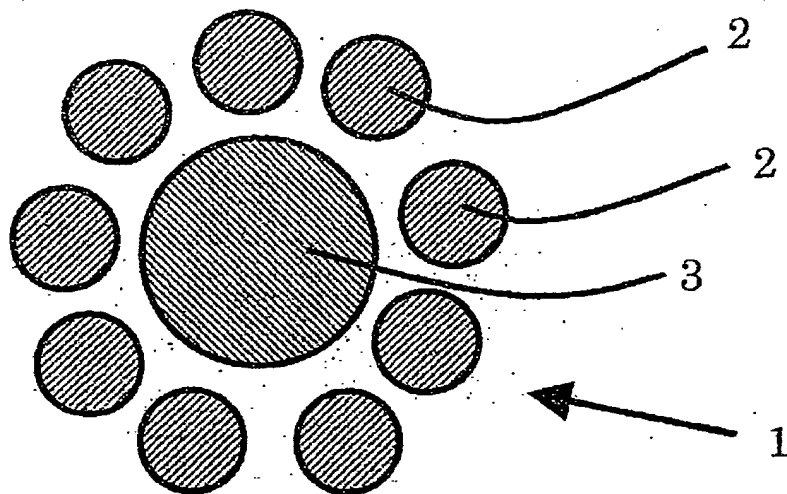
[Explanation of letters or numerals]

- 1 Hybrid cord
- 2 Glass fiber strand
- 3 Carbon fiber strand

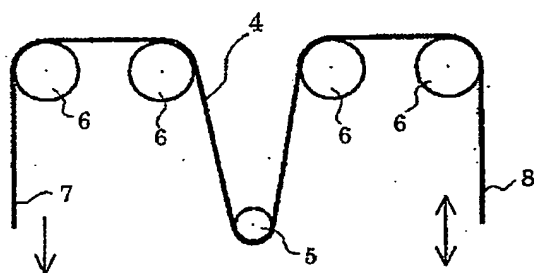
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[DOCUMENT NAME] FIGURE

[Figure 1]



[Figure 2]



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[Document Name] ABSTRACT

[Abstract]

[Object] A rubber-reinforcing hybrid cord is provided that has sufficiently high tensile strength as well as excellent bending fatigue
5 resistance, dimensional stability, and adhesiveness to rubber.

[Means to Solve the Problems] A rubber-reinforcing hybrid cord in which a carbon fiber strand is arranged at the center and a plurality of glass fiber strands are arranged therearound, and a rubber product
10 including the rubber-reinforcing hybrid cord. Preferably, the carbon fiber strand accounts for 20 to 80 vol% of the total volume of the carbon fiber strand and the glass fiber strands.

[Selected Figure] None